In the Claims

1. (Currently Amended) A cooling system comprising:

a cooling tube assembly for transferring heat from at least one electrical coil via a coolant traveling through the cooling tube assembly;

a heat exchanger for receiving the coolant from the cooling tube assembly and removing heat therefrom, the heat exchanger having a chiller to drive the coolant to a desired temperature;

a variable rate coolant pump configured to pump coolant to the cooling tube assembly at a flow rate;

an enclosure having the cooling tube assembly therein and having an internal dew point less than that of a surrounding atmosphere; and

a control system ~~that~~ configured to receives feedback indicative of operating conditions of the electrical coil and in response thereto, provides control signals to the chiller to dynamically adjust coolant temperature~~.~~, and configured to provide control signals to the coolant pump to adjust the flow rate to further adjust coolant temperature.

2. (Original) The cooling system of claim 1 further comprising a humidity removal device connected to the enclosure for removing humidity therefrom and maintaining the enclosure under a negative pressure.

3. (Original) The cooling system of claim 2 incorporated into an MRI scanner to control temperatures within a resonance module, on a patient bore surface, and on a warm bore surface adjacent to a magnet enclosure.

4. (Original) The cooling system of claim 2 wherein the humidity removal device includes:

a vacuum pump for removing humidity from the enclosure;

a pressure sensor for monitoring internal pressure in the enclosure; and

a control for monitoring the internal pressure in the enclosure and controlling the vacuum pump in response thereto.

5. (Original) The cooling system of claim 1 wherein the control system further comprises:

a temperature sensor to sense temperature of the electrical coil;

a humidity sensor to sense humidity within the enclosure; and

a computer to control the internal dew point in the enclosure in response to the humidity sensed and to control the electrical coil temperature in response to the sensed electrical coil temperature.

6. (Original) The cooling system of claim 5 wherein the computer controls the electrical coil temperature by dynamically adjusting the coolant temperature out of the chiller to maintain a relatively constant electrical coil temperature.

7. (Original) The cooling system of claim 4 further comprising a feedback control loop for maintaining a steady electrical coil temperature by dynamically adjusting coolant temperature through the cooling tube assembly in response to electrical coil temperature, and when the electrical coil temperature exceeds a given temperature, adjusting the coolant temperature below an ambient dew point temperature if necessary.

8. Cancelled

9. (Original) The cooling system of claim 3 wherein the control system is connected to sound an alarm or display a warning message and disable the electrical coils in response to an anomalous condition.

10. (Currently Amended) A cooling system for an MRI device comprising:

a set of coolant tubes in thermal contact with a set of gradient coils of the MR device and having a coolant pass therethrough;

a heat exchanger connected to the set of coolant tubes to remove heat from the coolant;

a vacuum chamber enclosing the set of coolant tubes;

at least one temperature sensor in thermal contact to sense temperature of the MR device; ~~and~~

a coolant flow control valve configured to regulate coolant flow through the set of coolant tubes; and

a controller connected to receive temperature indicative signals from the temperature sensor and regulate the coolant flow control valve to adjust coolant flow in the cooling system to control coolant temperature~~ in response thereto~~.

11. (Original) The cooling system of claim 10 further comprising:

a humidity sensor positioned to sense humidity in the vacuum chamber; and

wherein the controller is connected to receive humidity indicative signals and limit power to the MRI device if the humidity in the vacuum chamber exceeds a dew point level.

12. (Original) The cooling system of claim 10 further comprising:

a vacuum pump connected to the vacuum chamber;

at least one pressure sensor connected to sense pressure within the vacuum chamber; and

wherein the controller is connected to receive indicative pressure signals from the pressure sensor and in response thereto, control a vacuum pump to maintain a vacuum within the vacuum chamber.

13. Cancelled.

14. (Original) The cooling system of claim 10 having a first temperature sensor in thermal contact with a patient bore surface of the MRI device, a second temperature sensor in thermal contact with a resonance module, and a third temperature sensor in thermal contact with an outer bore surface, each temperature sensor connected to transmit temperature indicative signals to the controller such that the controller maintains temperatures for each sensor.

15. (Original) The cooling system of claim 10 further comprising a feedback loop to lower coolant temperature in response to an increase in gradient coil temperature.

16. (Original) The cooling system of claim 15 wherein the feedback loop and the temperature controller maintain the gradient coil temperature constant regardless of variations in power to the gradient coils.

17. (Original) An MRI apparatus comprising:

a magnetic resonance imaging (MRI) system having a plurality of gradient coils positioned about a bore of a magnet to impress a polarizing magnetic field and an RF transceiver

system and an RF switch controlled by a pulse module to transmit RF signals to an RF coil assembly to acquire MR images; and

a cooling system having:

a temperature sensor positioned to sense an indication of gradient coil temperature;

a set of coolant tubes having a coolant pass therethrough and in thermal contact with the gradient coils of the MR system;

a heat exchanger connected to the coolant tubes to remove heat from the coolant;

a vacuum chamber enclosing the coolant tubes;

a vacuum pump connected to the vacuum chamber;

at least one pressure sensor connected to sense pressure within the vacuum chamber; and

a control connected to receive signals from the pressure sensor and send signals to the vacuum pump to control and maintain a vacuum within the vacuum chamber, and connected to receive signals from the temperature sensor and control a coolant temperature in response, thereby maintaining a steady gradient coil temperature in and around the vacuum chamber.

18. (Original) The MRI apparatus of claim 17 further comprising:

a set of coolant supply/return lines having thermal insulation thereover and connecting the heat exchanger to the set of coolant tubes;

a humidity sensor positioned to sense humidity in the vacuum chamber and connected to the control, the control programmed to limit power to the gradient coils if the sensed humidity in the vacuum chamber exceeds a dew point.

19. (Original) The MRI apparatus of claim 17 further comprising a first temperature sensor in thermal contact with a patient bore surface of the MRI system, a second temperature sensor in thermal contact with a resonance module, and a third temperature sensor in thermal contact with an outer bore surface.

20. (Original) The MRI apparatus of claim 17 further comprising a coolant flow control valve connected to receive control signals from the control to adjust coolant flow control to the coolant system.

21. (Currently Amended) A method of cooling an MRI comprising the steps of:

creating a sealed enclosure about a set of gradient coils;

removing moisture from the sealed enclosure;

recirculating a coolant through a series of cooling tubes in the sealed enclosure and through a heat exchanger;

monitoring an indication of gradient coil temperature during MR operation;~~ and~~

adjusting a temperature of the coolant in response to the indication of gradient coil temperature~~.~~;

monitoring an indication of internal pressure in the sealed enclosure; and

adjusting an internal pressure in the sealed enclosure in response to the indication of internal pressure in the sealed enclosure.

22. (Original) The method of claim 21 further comprising the steps of:

providing the indication of gradient coil temperature feedback in real-time; and

lowering coolant temperature below an ambient dew point if necessary to allow higher power levels to the gradient coils.

23. (Original) The method of claim 22 further comprising the steps of:

monitoring a humidity level in the sealed enclosure; and

limiting power to the gradient coils if the coolant level needed would create condensation in the sealed enclosure based on the humidity level monitored.

24. (Original) The method of claim 21 wherein the step of removing moisture is performed by creating a vacuum in the sealed enclosure.

25. (Currently Amended) A coolant control system kit adaptable to an MR device comprising:

a humidity sensor positioned to sense humidity in a resonance module;

at least one temperature sensor in thermal contact to sense temperature of a portion of the MR device; ~~and~~

a controller connected to receive temperature indicative signals from the temperature sensor and control coolant flow~~temperature~~ in response thereto.

26. (Original) The coolant control system kit of claim 25 wherein the at least one temperature sensor includes a first temperature sensor in thermal contact with a patient bore surface of the MRI device, a second temperature sensor in thermal contact with a resonance module, and a third temperature sensor in thermal contact with an outer bore surface, each temperature sensor connected to transmit temperature indicative signals to the controller such that the controller maintains temperatures for each sensor within a given range.

27. (Original) The coolant control system kit of claim 25 wherein a humidity sensor is positioned to sense humidity in the vacuum chamber, and wherein the controller is connected to receive humidity indicative signals and limit power to the MRI device if the humidity in the vacuum chamber exceeds a dew point level.

28. (Currently Amended) An MR cooling system comprising:

means for transferring heat from at least one electrical coil via a coolant traveling therethrough;

means for receiving the coolant from the means for transferring heat and removing therefrom;

an enclosure having the means for transferring heat therein and having an internal dew point less than that of a surrounding atmosphere; and

a control means for receiving feedback indicative of operating conditions of the electrical coil and in response thereto, dynamically adjusting coolant temperature<u>, and for receiving feedback indicative of internal pressure in the enclosure and in response thereto, dynamically adjusting internal pressure in the enclosure</u>.

29. (Original) The MR cooling system of claim 28 further comprising:

a means for removing humidity from the enclosure;

a pressure sensor means for monitoring internal pressure in the enclosure; and

a control means for monitoring the internal pressure in the enclosure and controlling the means for removing humidity in response thereto.

30. (Original) The MR cooling system of claim 28 further comprising:

a means for sensing temperature of the electrical coil;

a means for sensing humidity within the enclosure; and

a means for controlling the internal dew point in the enclosure in response to the humidity sensed and for controlling the electrical coil temperature in response to the sensed electrical coil temperature.